

Air Quality Impacts of the Use of Ethanol in California Reformulated Gasoline

January 18, 2000

California Environmental Protection Agency



Air Resources Board

Presentation Outline

Introduction

Review of Prior Studies

Emission and Air Quality Predictions

Resolution of Uncertainties

Conclusions

Introduction

Study Approach

Review recent assessments of oxygenated gasolines

Review ambient air quality studies

Predict emission and air quality impacts of MTBE-free gasolines

Address data gaps

Compounds Studied

Ethanol → Acetaldehyde → PAN

MTBE → Formaldehyde

Alkylates → Aldehydes → PAN

Others

benzene, 1,3-butadiene

***n*-heptane, *n*-hexane, isobutene,
toluene, xylenes**

PPN, ozone, CO, NO₂, PM10, PM2.5

Review Process

Public

Individual stakeholder meetings

Workshops on 7/12, 10/4, and 11/10

ARB hearing on 12/9

Web page with email notification

Scientific

Contract emission and PAN experts

Formal University of California peer review

UC Peer Reviewers

Professor Roger Atkinson (UCR)

Professor Barbara Finlayson-Pitts (UCI)

Dr. Donald Lucas (LBNL/UCB)

Professor John Seinfeld (Caltech)

Review of Prior Studies

Recent Assessments of Oxygenated Gasolines

Reviewed 8 reports

UC MTBE Report

U.S. EPA Blue Ribbon Panel

Identified issues of concern

**Lacked review of ambient air quality
studies and analysis of MTBE-free fuels**

Emission Issues

Commingling mitigated by CaRFG3 regs

Permeation and canister working capacity

Comparison to MTBE needed

Addressed by U.S. EPA Tier 2 certification fuel

Transportation of ethanol

0.06% increase in truck emissions

Local impacts addressed by CEQA

Ambient Air Quality Studies

Reviewed 16 articles and reports

U.S. (Denver, Albuquerque)

Brazil

**Air quality impact substantial only
in Brazil with high-ethanol fuels
and no RVP limits**

Emission and Air Quality Predictions

Methodology

Focus on South Coast Air Basin

Estimate emissions for airshed modeling

Model air quality for 1997 and 2003 episode

**Use model results to scale measured 1997
air quality baseline to 2003**

Fuels

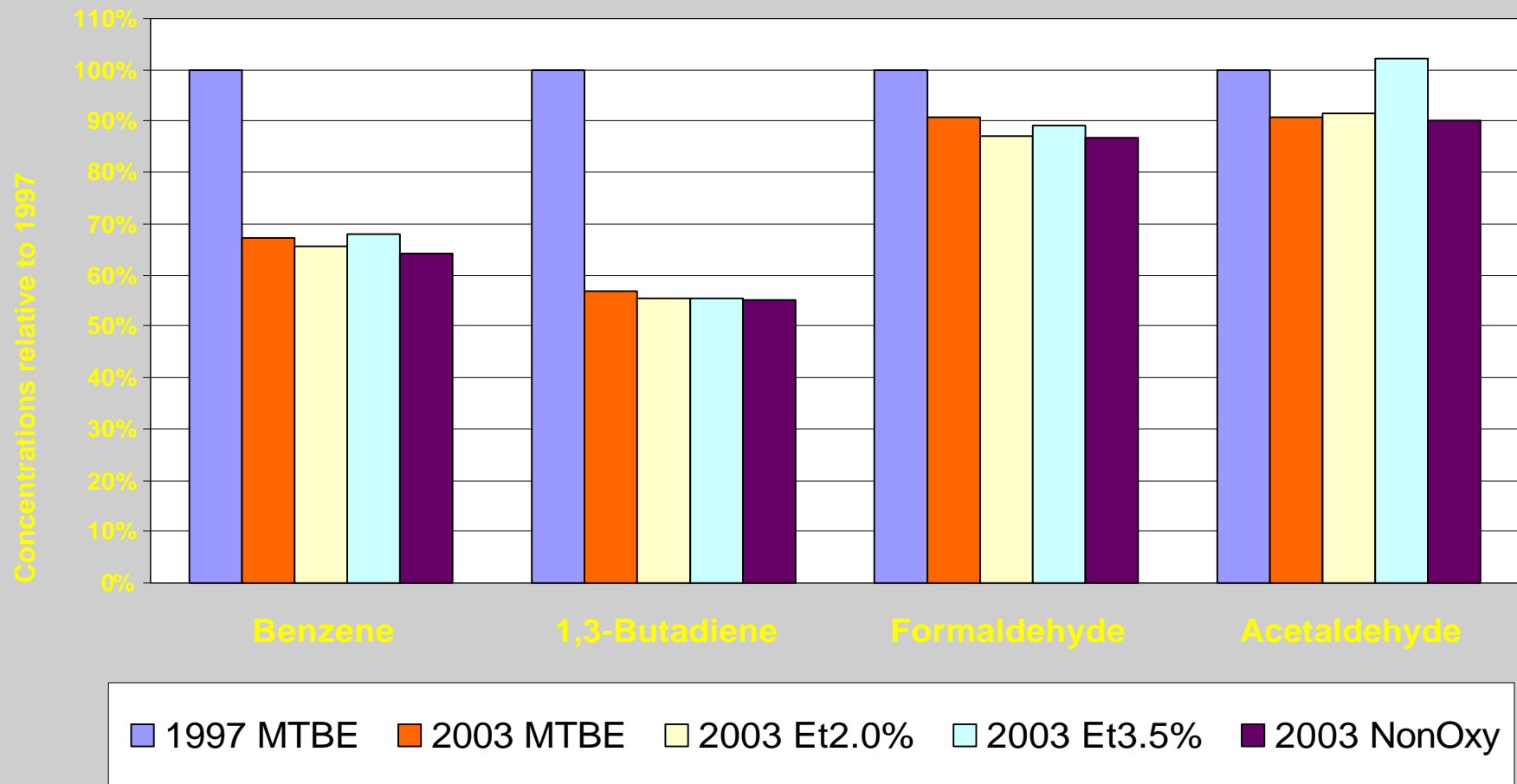
**Current MTBE-based Phase 2 CaRFG
1997 and 2003**

Ethanol blend at 2.0 wt% oxygen (5.7%)

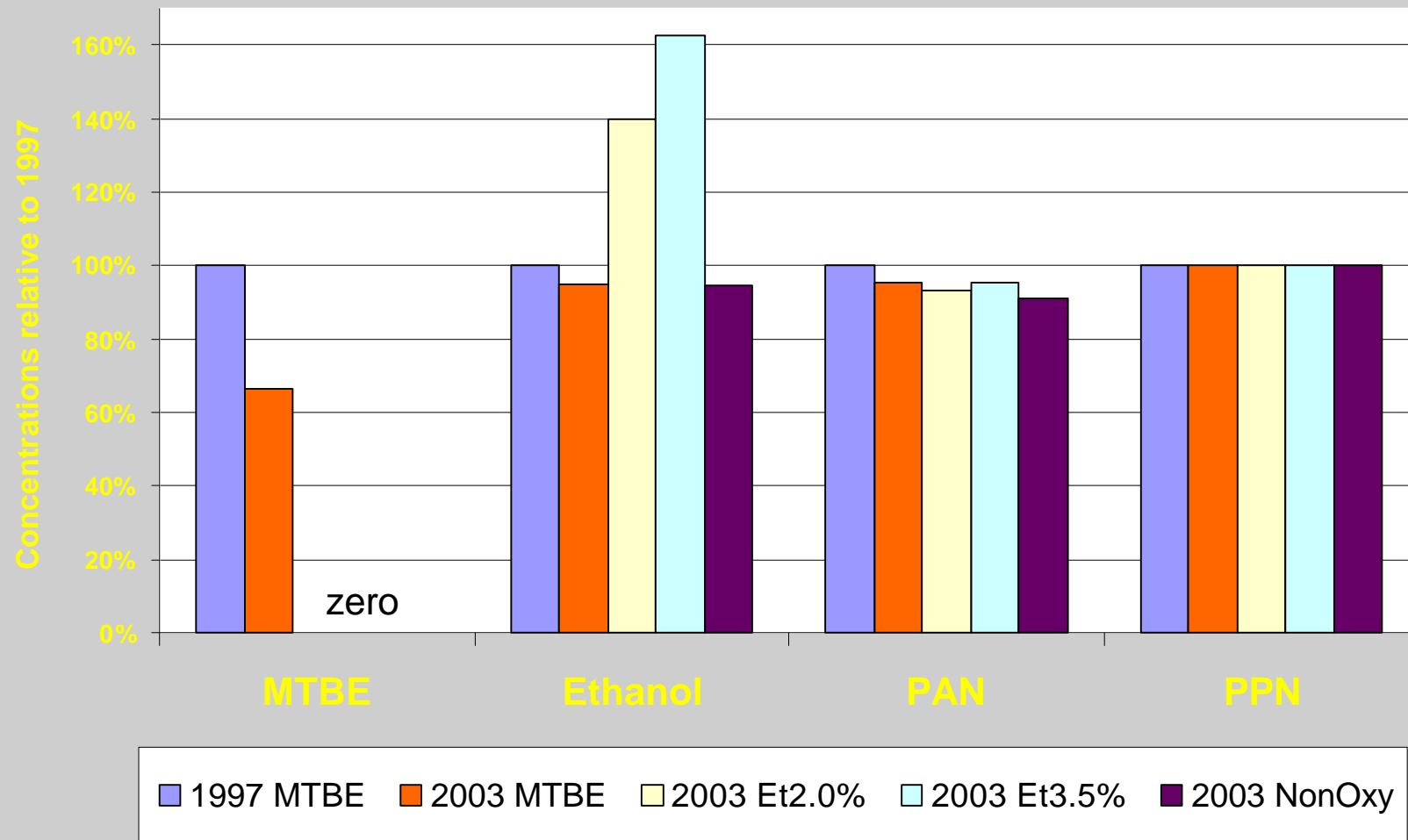
Ethanol blend at 3.5 wt% oxygen (10%)

Non-oxygenated fuel

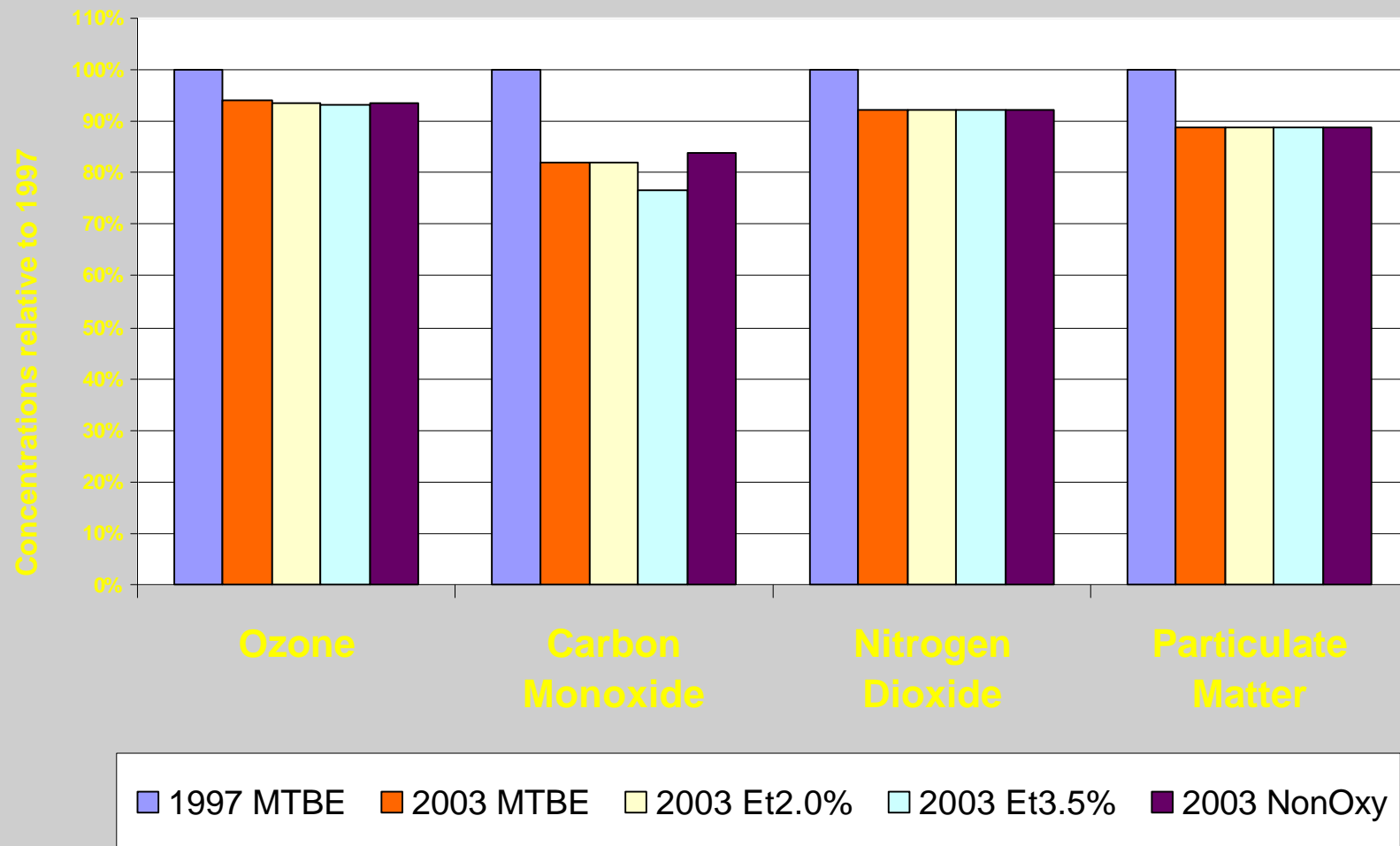
Predicted Average Concentrations for Toxic Air Contaminants



Predicted Maximum Concentrations for Other Pollutants of Concern



Predicted Maximum Concentrations for Criteria Pollutants



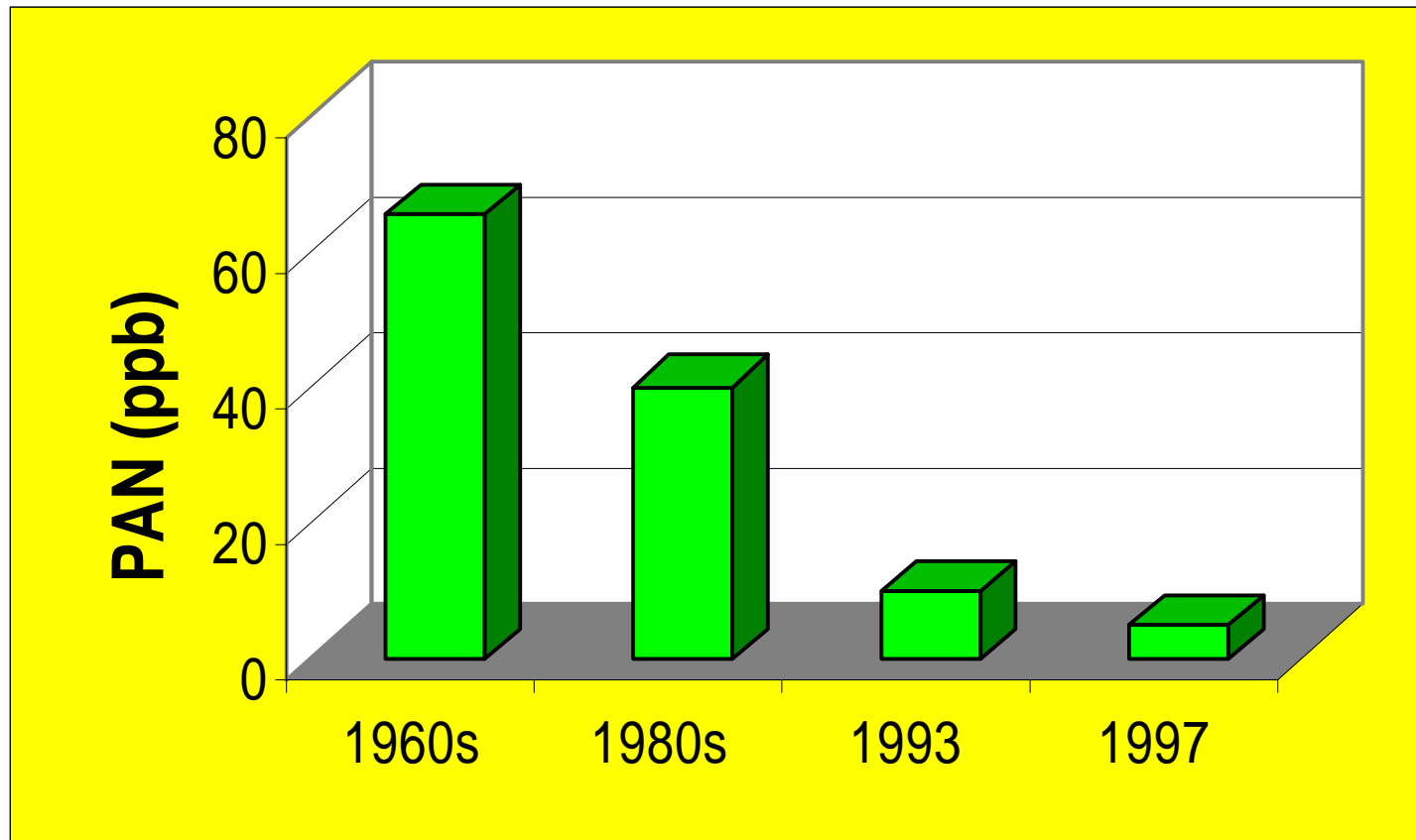
Other Results

No indication of health problem with alkylates from OEHHA

***n*-Heptane, *n*-hexane, isobutene, toluene, and xylenes below level of concern**

Simpler models for South Coast Air Basin and Brazil support lack of PAN formation from ethanol substitution

Ambient PAN Measurements in South Coast Air Basin



Resolution of Uncertainties

Uncertainties

Emissions

Effect of EMFAC2000 bracketed

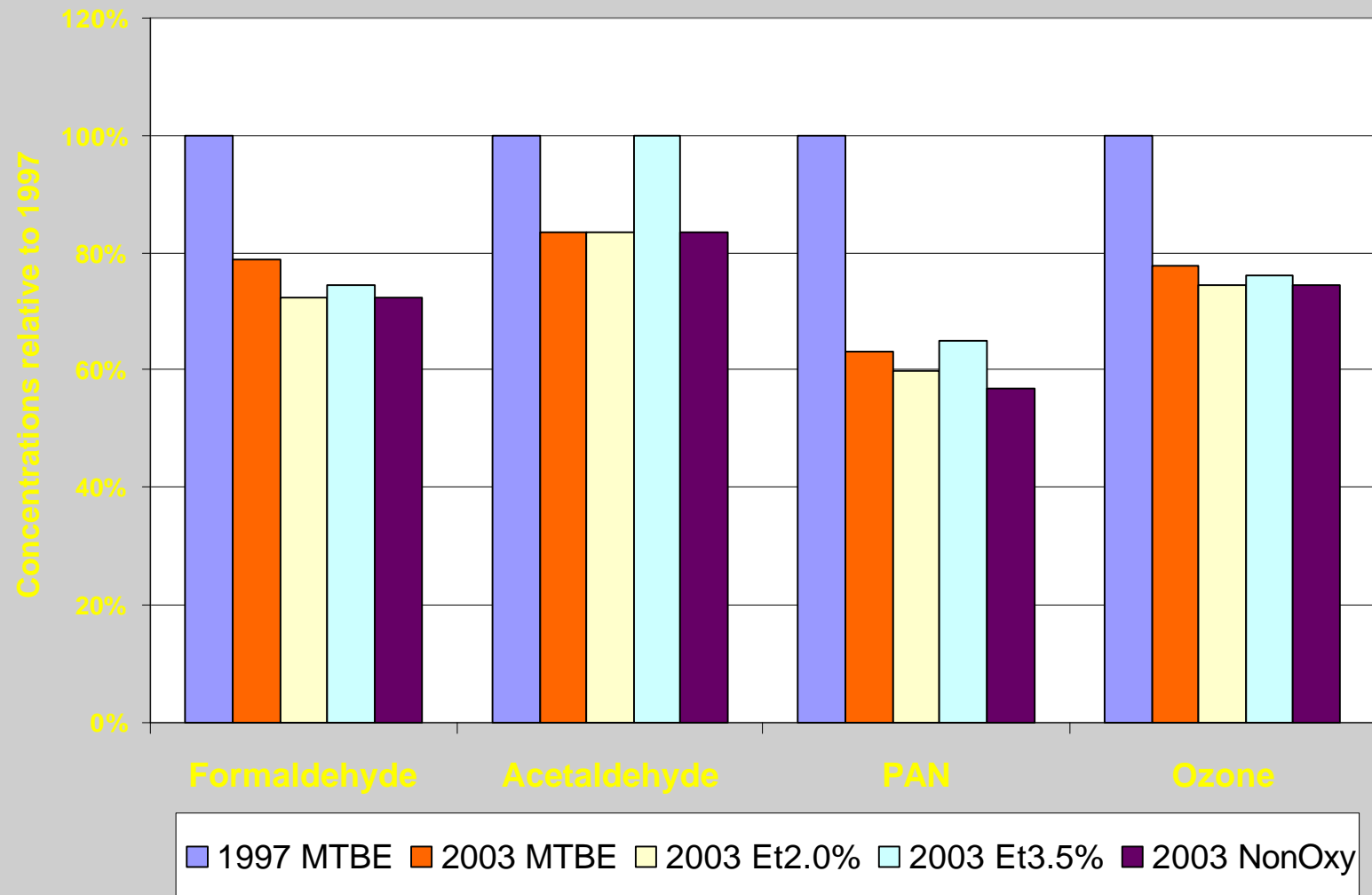
Modeling

**Chemistry of ethanol, MTBE, and alkylates
are well-known**

Chlorine chemistry included

Use in relative sense bypasses other issues

Upper-Bound Concentrations for Selected Pollutants



Ambient Air Quality Monitoring Program

Measure air quality impacts of fuels

**Criteria pollutants and toxic air
contaminants already monitored**

PAN monitoring began in November

Ethanol method needs development

Conclusions

Conclusions

So long as the CaRFG3 regulations address the potential for ethanol usage to increase evaporative emissions and to cause more rail and truck traffic, the substitution of ethanol and alkylates for MTBE in California's fuel supply will not have any significant air quality impacts.

Conclusions, cont.

The results of this study do not necessarily extend to other states. States without CaRFG3's unique safeguards may have significant air quality impacts from replacement of MTBE with ethanol or aromatic compounds.